ALL CANCELED NOISE

S RECEPTION SIGNAL

N NOISE

PWR

FREQUENCY

FIG. 1B
PRESENT INVENTION

N NOISE

S RECEPTION SIGNAL

N1

S1

CUT NOISE

PWR

FREQUENCY

FIG. 1A
PRIOR ART

FIG. 2A PRIOR ART

FIG. 2B PRESENT INVENTION

FIG. 3A
192kB TRANSMISSION

FIG. 3B
TRANSMISSION AFTER
ZERO-POINT INSERTION

FIG. 3C
RECEPTION SIGNAL

FIG. 3D
NOISE INTERPOLATION
SIGNAL

FIG. 3E
AFTER NOISE CANCELATION

S: SIGNAL   N: NOISE
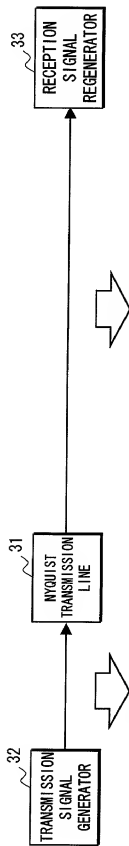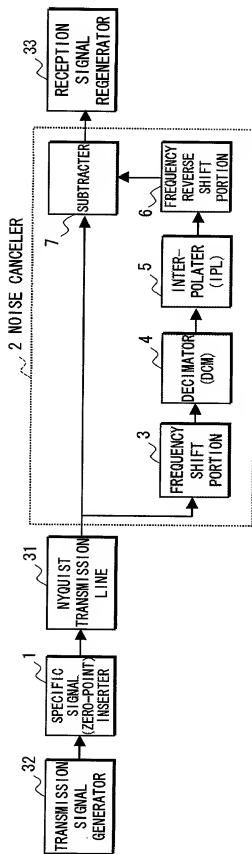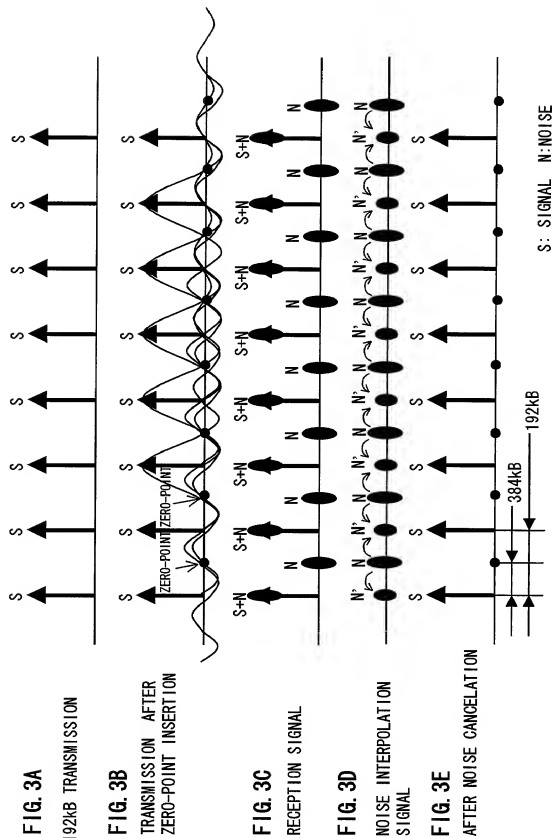
FIG. 4A SIGNAL POINT ON TRANSMISSION SIDE
(UPON 192kB TRANSMISSION AFTER GENERATING TRANSMISSION SIGNAL POINT)

FIG. 4B SIGNAL POINT ON TRANSMISSION SIDE (384kB AFTER ZERO-POINT INSERTION)

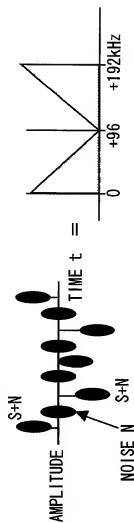FIG. 4C SIGNAL POINT ON RECEPTION SIDE (384kB AFTER NYQUIST TRANSMISSION LINE)
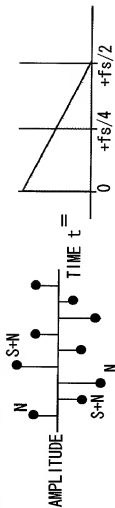
FIG. 5A SAMPLE VALUE & SPECTRUM OF SIGNAL S(n)

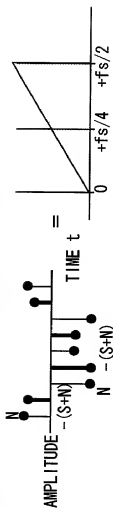FIG. 5B SAMPLE VALUE & SPECTRUM OF SIGNAL $(-1)^n * S(n)$
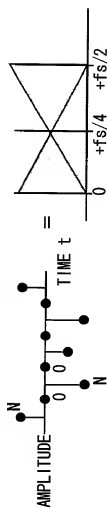
FIG. 5C SAMPLE VALUE & SPECTRUM OF SIGNAL t(n)

FIG. 5D SAMPLE VALUE & SPECTRUM OF SIGNAL u(n)

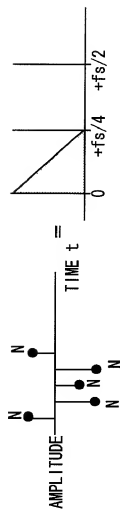**FIG. 6A** SAMPLE VALUE & SPECTRUM OF SIGNAL $u(n)$

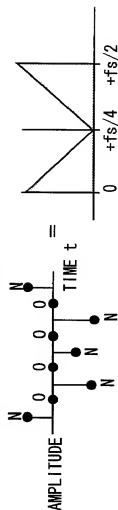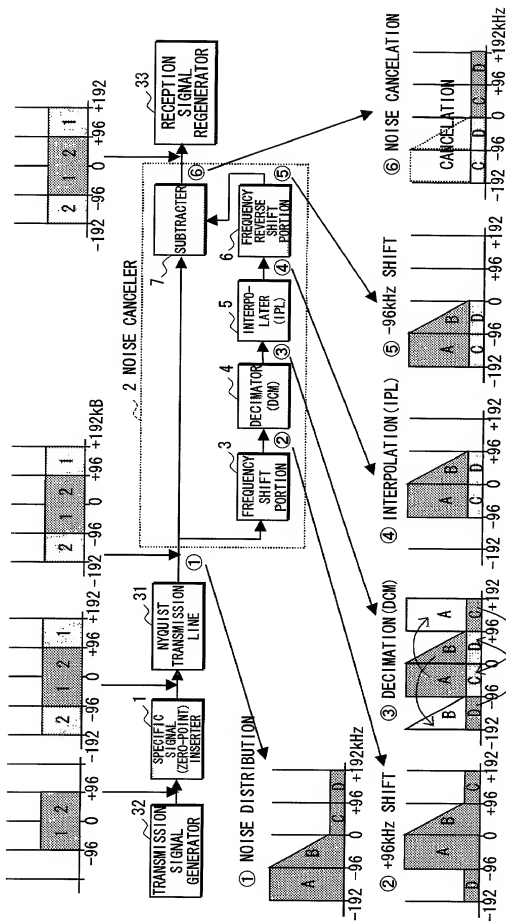**FIG. 6B** SAMPLE VALUE & SPECTRUM OF SIGNAL $t(n)$

FIG. 7

FIG. 8A

ZERO-POINT: INSERTED INTO EVERY 4TH SIGNAL POINT
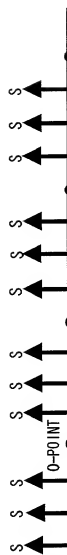
INTERPOLATED NOISE BANDWIDTH: 96kHz

FIG. 8B

ZERO-POINT: INSERTED INTO EVERY 3RD SIGNAL POINT

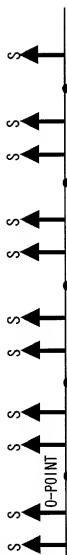INTERPOLATED NOISE BANDWIDTH: 128kHz

FIG. 8C

ZERO-POINT: INSERTED INTO EVERY OTHER SIGNAL POINT
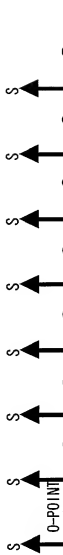
INTERPOLATED NOISE BANDWIDTH: 192kHz

FIG. 8D

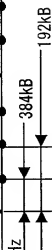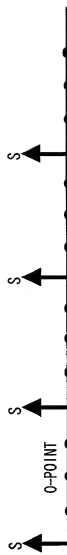ZERO-POINT: 2 ZERO-POINTS INSERTED BETWEEN SIGNAL POINTS

INTERPOLATED NOISE BANDWIDTH: 256kHz

FIG. 8E

ZERO-POINT: 3 ZERO-POINTS INSERTED BETWEEN SIGNAL POINTS

INTERPOLATED NOISE BANDWIDTH: 288kHz

FIG. 9A LOW-PASS FILTER

INTERPOLATION BANDWIDTH

▲ NUMBER OF TAPS IS LARGE & CANCELATION RANGE IS SMALL

○ NO ALIASING OUTSIDE INTERPOLATION BANDWIDTH
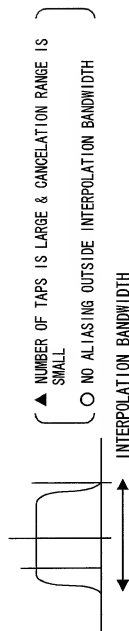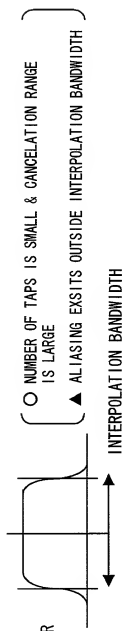
FIG. 9B COS-SQUARED FILTER

INTERPOLATION BANDWIDTH

○ NUMBER OF TAPS IS SMALL & CANCELATION RANGE IS LARGE

▲ ALIASING EXISTS OUTSIDE INTERPOLATION BANDWIDTH

FIG. 9C COS FILTER

INTERPOLATION BANDWIDTH

▲ NUMBER OF TAPS IS LARGE & CALCULATION AMOUNT IS LARGE

▲ ALIASING EXISTS OUTSIDE INTERPOLATION BANDWIDTH

FIG. 10A

NYQUIST TRANSMISSION LINE 31

FIG. 10B

NYQUIST INTERVAL 384kB

ZERO-POINT

TIME AXIS t

FIG. 11

SIGNAL AFTER NOISE CANCELATION (384kB)

RECEPTION SIGNAL (x+jy)

384kB

FREQUENCY SHIFT PORTION 3

C=[(xcoswt-ysinwt) +j(xsinwt+ycoswt)]

DECIMATOR (DCM) 4

192kB

DELAY CIRCUIT 9

DELAY CIRCUIT 8

INTERPOLATER (IPL)

FREQUENCY REVERSE SHIFT PORTION 6

ZERO-POINT SIGNAL

192kB

+f0=(coswt+jsinwt)

FIG. 12

NOISE SIGNAL (D)
SAMPLING INTERVAL T

192kB

ZERO-POINT INSERTER
51

384kB

521

T/2   T/2   T/2   T/2

522

×   ×   ×   ×
C1   C2   C3   Cn

Σ

INTERPOLATION FILTER
52

384kB

INTERPOLATION SIGNAL (E)

5

FIG. 13

FROM ROF → PWR (231) → BPF (232) → VECTO-RIZING (233)

23

REFERENCE POINT → COMPAR-ATOR (241) → LPF (242) → SECON-DARY PLL (243) → D/A (244) → VCXO (245) → FREQUENCY DIVIDER (246) → ZERO-POINT SIGNAL

24

TO A/D CONVERTER

(TIME INFORMATION AT REFERENCE POINT)
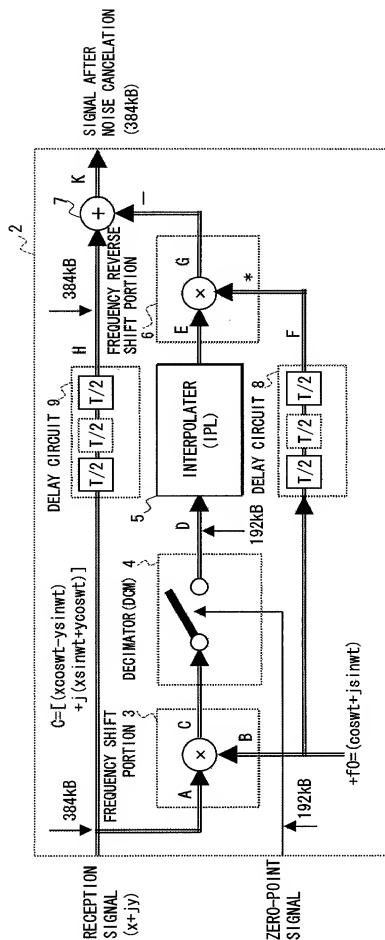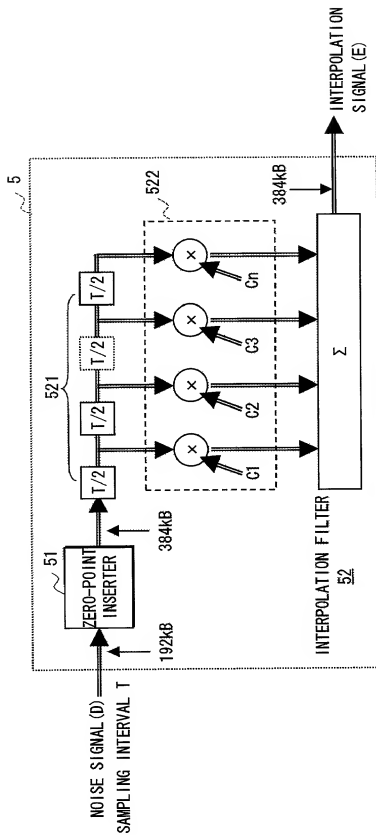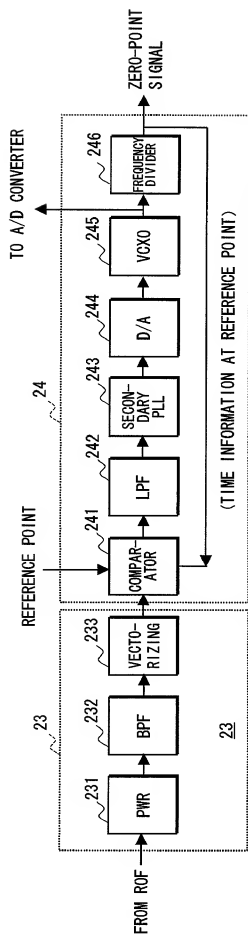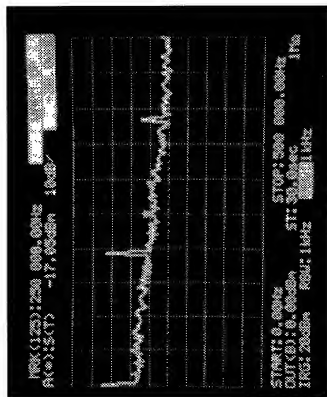
FIG. 14

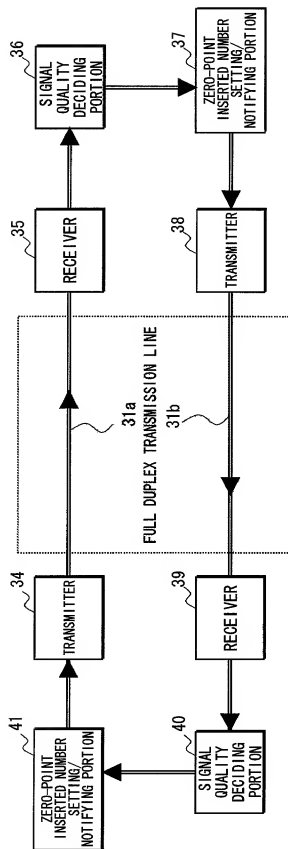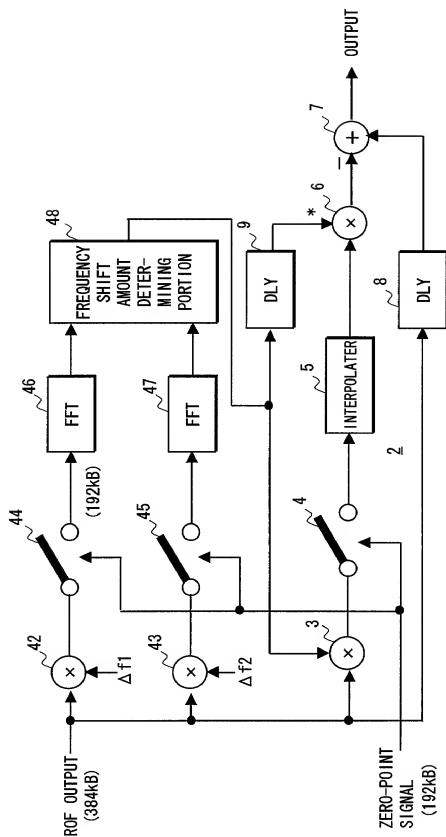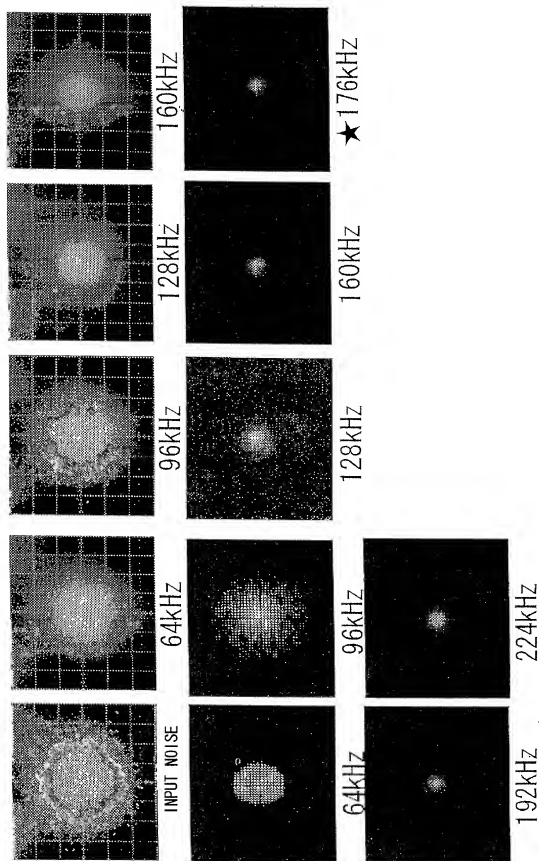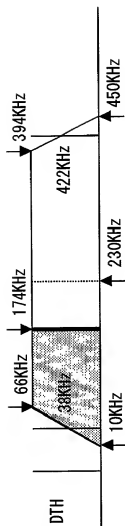(LINE SPECTRUM IN THE CENTER OF THE PHOTO IS ZERO-POINT SIGNAL OF 192kHz)

FG75CD" SG6GF96U

FIG. 15

SIGNAL QUALITY DECIDING PORTION 36

ZERO-POINT INSERTED NUMBER SETTING/NOTIFYING PORTION 37

RECEIVER 35

TRANSMITTER 38

31a

FULL DUPLEX TRANSMISSION LINE

31b

TRANSMITTER 34

RECEIVER 39

ZERO-POINT INSERTED NUMBER SETTING/NOTIFYING PORTION 41

SIGNAL QUALITY DECIDING PORTION 40

FIG. 16

FIG. 17

FIG. 18A
TRANSMISSION BANDWIDTH
(LINE SIGNAL)

66KHz 38KHz 10KHz 174KHz 230KHz 394KHz 422KHz 450KHz

FIG. 18B
BASEBAND
(ROF OUTPUT)

−56KHz −164KHz −192KHz −220KHz 0KHz +164KHz +192KHz +220KHz
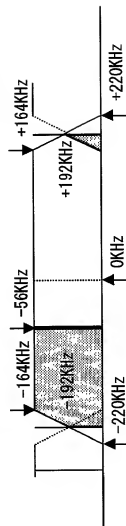
FIG. 18C
AFTER FREQUENCY SHIFT
(AFTER +138kHz SHIFT)

−26KHz −54KHz −82KHz +82KHz +138KHz +302KHz +330KHz +358KHz

FIG. 19

FIG. 20

PRIOR ART

PWR

TX SPECTRUM OF TRANSMISSION SIGNAL

FREQUENCY

FIG. 21A

LINE CHARACTERISTIC

FIG. 21B

PWR

N NOISE LEVEL

RX SPECTRUM OF RECEPTION SIGNAL

FREQUENCY

FIG. 21C